

CLAIMS

What is claimed is:

1. A method for planarizing a semiconductor wafer having an insulating layer on a surface thereof, the insulating layer comprising a field region and a plurality of features, the method comprising the steps of:

forming a barrier layer overlying at least the field region;

electrodepositing a layer comprising copper having a substantially planar upper surface overlying the barrier layer and filling the features in the insulating layer; and

polishing the layer comprising copper and the barrier layer on a single polishing pad to remove the layer comprising copper and the barrier layer from the field region.

2. The method of claim 1 wherein the step of polishing comprises the step of chemical mechanical planarizing the layer comprising copper and the layer of barrier material on a single soft polishing pad.

3. The method of claim 2 wherein the step of polishing comprises the step of chemical mechanical planarizing on a polishing pad having a hardness less than about 0.4 on the Shore D hardness scale.

4. The method of claim 2 wherein the step of chemical mechanical planarizing comprises the step of chemical mechanical planarizing in the presence of a polishing slurry having a copper:barrier layer selectivity of substantially 1:1.

5. The method of claim 2 wherein the step of chemical mechanical planarizing comprises the steps of:

chemical mechanical planarizing in the presence of a first slurry having a selectivity of copper:barrier greater than 1:1 to remove a first portion of the layer comprising copper; and

chemical mechanical planarizing in the presence of a second slurry having a copper:barrier layer selectivity of substantially 1:1.

6. The method of claim 2 further comprising the steps of cleaning and buffing the field region on the single platen following the step of polishing.

7. The method of claim 1 wherein the step of forming a barrier layer comprises the step of forming a barrier layer overlying at least the field region comprising a low-k dielectric material insulating layer.

8. The method of claim 7 further comprising polishing the insulating layer on the single polishing pad to planarize the field region.

9. The method of claim 1 wherein the step of electrodepositing comprises the step of electrodepositing on a first platen of a multi-platen apparatus and the step of polishing comprises the step of polishing on a second platen of the multi-platen apparatus.

10. The method of claim 9 further comprising the step of cleaning the polished copper layer on a buff polishing station on a third platen of the multi-platen apparatus.

11. The method of claim 1 wherein the step of electrodepositing comprises the steps of:

forming a first seed layer comprising copper overlying the barrier layer; and

electrodepositing over the first seed layer a second layer comprising copper having a thickness less than about 300 nm as measured over the field region.

12. The method of claim 1 wherein the step of chemical mechanical planarizing comprises the step of chemical mechanical planarizing in the presence of a polishing slurry having a copper:barrier layer selectivity of substantially 1:1.

13. A method for planarizing a semiconductor wafer having an insulating layer on a surface thereof, the insulating layer comprising a low-k dielectric material having a field region and a plurality of features, the method comprising the steps of:

forming a barrier layer overlying the insulating layer;

forming a seed layer comprising copper overlying and contacting the barrier layer;

electrochemical mechanical plating a layer comprising copper having a substantially planar upper surface overlying the seed layer and filling the features;

chemical mechanical polishing the layer comprising copper and the barrier layer on a single polishing platen to remove the layer comprising copper and the barrier layer from the field region.

14. The method of claim 13 wherein the step of chemical mechanical polishing comprises the step of electrochemical mechanical polishing.

15. The method of claim 13 wherein the step of chemical mechanical polishing comprises the steps of:

chemical mechanical polishing in the presence of a first slurry having a selectivity of copper:barrier layer greater than 1:1 to remove a first portion of the layer comprising copper; and

chemical mechanical polishing in the presence of a second slurry having a copper:barrier layer selectivity of substantially 1:1.

16. The method of claim 13 wherein the step of chemical mechanical polishing comprises the step of chemical mechanical polishing the layer comprising copper and the barrier layer on a soft polishing pad on the single polishing platen.

17. A method for planarizing a work piece having a surface comprising a plurality of features and a field region, the method comprising the steps of:

forming a barrier layer overlying the field region and extending into the features;

electrodepositing a metal layer overlying the barrier layer and filling the features, the metal layer having a substantially planar upper surface over the features and the field region;

polishing the metal layer and the barrier layer on a single polishing pad to remove the metal layer and the barrier layer from the field region.

18. The method of claim 17 wherein the steps of electrodepositing and polishing comprise electrodepositing and polishing on two platens of a multi-platen electrochemical mechanical planarization apparatus.

19. The method of claim 17 wherein the steps of electrodepositing and polishing comprise the steps of:

electrodepositing a metal layer at a first platen of the multi-platen apparatus;

robotically moving the work piece to a second platen of the multi-platen apparatus;
and

polishing the metal layer and the barrier layer at the second platen.

20. The method of claim 17 wherein the work piece is mounted on a work piece carrier and wherein the steps of electrodepositing and polishing comprise the steps of:

aligning the work piece carrier with respect to a first platen of the multi-platen apparatus;

electrodepositing a metal layer at the first platen;

aligning the work piece carrier with respect to a second platen of the multi-platen apparatus; and

polishing the metal layer and the barrier layer at the second platen.

21. The method of claim 17 wherein the step of polishing the metal layer and the barrier layer on a single polishing pad comprises the step of polishing on a polishing pad having a hardness of less than about 0.4 on the Shore D hardness scale and at a pressure between the work piece and the polishing pad of less than about 2.5 psi.